1-1-1963

Glacial Geology, Providence to Point Judith

Schafer, J.P.

TRIP C

GLACIAL GEOLOGY, PROVIDENCE TO POINT JUDITH

(Publication authorized by the Director, U. S. Geological Survey)
J. P. Schafer, U.S. Geological Survey

Map Coverage

Map Coverage For Trip C, Glacial Geology, J. P. Schafer:

Topographic maps (1:24,000):

Providence, East Greenwich, Crompton, Wickford, Narragansett Pier, Kingston, and Slocum; Rhode Island.

Surficial Geologic Quadrangle Maps: (all available from Map Information Office, U.S. Geological Survey, G.S.A. Building, Washington 25, D.C., at $1.00 each)

Providence, GQ-84
East Greenwich, GQ-62
Crompton, GQ-94
Wickford, GQ-136
Narragansett Pier, GQ-140
Slocum, GQ-106

U.S. Geological Survey Bulletin 1071-I, Surficial geology of the Kingston quadrangle, Rhode Island; available at $1.50 from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Itinerary

EN ROUTE TO STOP 1 (9 miles)

We cross, on Routes 2 and 3, an extensive kettled outwash plain in Providence and Cranston, and then a long hill of Pennsylvanian metasedimentary rocks veneered by dark-gray till (Smith, 1956a).

STOP 1. Gravel pit at Pontiac, on east side of Routes 2 and 3, East Greenwich quad. (235,500 ft. N, 505,700 ft. E; State plane coordinates, shown by 10,000-foot tick marks on margins of topographic maps.)

This section in partly collapsed ice-contact deposits (Smith, 1955) shows:

5. Late-glacial eolian silty sand, with ventifacts.
4. Stratified sand; perhaps mostly eolian sand deposited in a pond.
3. Glaciofluvial gravel and sand; thicker westward.
2. Dark-gray flowtill, rich in Pennsylvanian rock debris; stones are mostly rounded pebbles and cobbles from gravel; probably deposited as a mudflow from adjacent dead ice mantled by ablation moraine.
1. Glaciofluvial gravel and sand.

The excavation here uncovered Pennsylvanian sandstone; glacial grooves are N 20-70° W

EN ROUTE TO STOP 2 (4 miles)

We travel generally westward, first along the swampy floodplain of the Pawtuxet River, then up the marginal scarp of the Narragansett basin (outcrops

of basal Pennsylvanian conglomerate on scarp south of road) and across the upland of crystalline rocks.

STOP 2. Rottenstone pit, north of Harris, Crompton quad. (235,400 ft. N, 491,600 ft. E)

This pit is in one of several Rhode Island areas of weathered bedrock (Smith, 1956b). The weathering occurs mostly in coarse-grained granitic rocks, and penetrates locally to depths of at least a few tens of feet. As the weathered rock is overlain at many places by unweathered till, the weathering occurred before the last glaciation, and is of interglacial or preglacial age. The weathering generally consists of disintegration caused by a rather small amount of decomposition of feldspar and biotite. The resulting gruss, commonly known as rottenstone, is excavated for such uses as surfacing driveways. The rock in this pit is gray perthitic granite, composed mainly of quartz, microperthite, and biotite. The weathered rock shows a platy structure that is independent of foliation and is generally parallel to the surface. Joint-controlled spheroidal weathering is shown by the core stones, which at this pit are unusually flat ellipsoids, and by the rock surface beneath the gruss. The rounded outcrops of relatively sound rock just north of the pit are essentially glaciated tors. Much more strongly decomposed rock, representing a higher part of the original weathering profile, has been found at a few places in the State.

EN ROUTE TO STOP 3 (6 miles)

We go a short distance north past other rottenstone exposures; then south through West Warwick, mostly on till; and southwest on New London Turnpike, onto a collapsed glaciofluvial terrace at 240-280 feet, and to the head of a higher terrace.

STOP 3. Gravel pit in esker, northeast of intersection of New London Turnpike and Arnold Road, Crompton quad. (212,000 ft. N, 488,500 ft. E)

STOP 4. Gravel pit at crest of ice-contact slope, 1000 feet southeast of Stop 3, Crompton quad. (211,700 ft. N, 489,200 ft. E)

These two pits show the materials and structures at the collapsed ice-contact head of a 330-350-foot terrace, higher and older than the 240-280-foot terrace that we crossed immediately to the north (Smith, 1956b). The disappearance of the last ice sheet from much of southern New England is recorded by such bodies of stratified drift, each with an ice-contact head built against or on the edge of the stagnant marginal zone of the ice. These chronologic units have been called sequences.

The esker at Stop 3 is composed mostly of relatively well bedded and well sorted gravel and sand, strongly collapsed on both sides of the ridge. Kettle deposits are banked against the ridge, which may well have been formed in a tunnel rather than in an open channel.

The pit at Stop 4 includes much material that is cruder than that at Stop 3 -- gravel and sand of various degrees of sorting and bedding, and some till masses. Boulders are abundant, and some are of rottenstone. Several small kettles are filled with thick eolian material. The pit bottomed on bedrock, unweathered Scituate Granite Gneiss, glacially polished but not striated.

EN ROUTE TO STOP 5 (24 miles)

This part of the trip may be divided into segments as follows:

a) 5 miles; east on Division Street and then south on Route 2 to Frenchtown, mostly over till-mantled crystalline bedrock upland.
b) 7 miles; south on Route 2 and then Colonel Rodman Highway to Allenton, over ice-contact glaciofluvial deposits and "morainic kames" (knobs of unpredictable mixtures of till and sorted materials; Schafer, 1961a).
c) 1½ miles; detour onto Old Post Road, across a 40-50-foot terrace and up ice-contact head onto a 110-130-foot terrace (Schafer, 1961a); road follows crest of a steep-sided esker for part of climb up slope; relations very similar to those between the two terraces at Stops 3 and 4.
d) 6 miles; south on Tower Hill Road (US 1, formerly US 1A) to Wakefield, over a long till-bedrock hill.
e) 4 miles; south on Point Judith Road along crest of Point Judith Neck; ablation-moraine deposits mapped as the Point Judith moraine (Schafer, 1961b), believed to have been deposited at the west side of the Narragansett Bay-Buzzards Bay ice lobe; but the north part of this ridge conceals a bedrock high.

STOP 5. Lunch at seafood restaurant at Galilee, Kingston quad.

EN ROUTE TO STOP 6 (2½ miles).

We travel southeast along Sand Hill Cove beach, the easternmost of the long beaches between Watch Hill and Point Judith, and across ablation moraine to Point Judith.

STOP 6. Sea cliff at Breakwater Village (Point Judith village on topographic map), Narragansett Pier quad. (102,400 ft. N, 502,700 ft. E)

This cliff exposes till and till-like material locally overlain by or interbedded with sand and silt. The stratification is more or less deformed, presumably as a result of collapse. However, some of the strong contortion in the upper few feet appears to die out downward, and may be a result of late-glacial frost action. The drift is overlain by late-glacial eolian sandy silt that contains ventifacts.

Stones of gray Pennsylvanian sedimentary rocks are abundant, although this locality is outside the Narragansett basin. Two cobbles of cumberlandite found on the beach here represent the west edge of the indicator fan of this distinctive rock type, derived from an outcrop area 44 miles north. The thinness of the beach deposit is shown by the patches of bare till platform on the foreshore.

The short, low cliff just west of the main cliff shows a soil profile developed under poorly drained conditions. The sag between this cliff and the main cliff is the landward side of a former shallow kettle, now breached by marine erosion. A remnant of an organic deposit in this kettle is exposed on the beach and contains abundant wood, many pieces of which show beaver tooth marks (Kaye, 1962). A radiocarbon date (OWU-22) of about 10,850 years B.P. has been obtained from this deposit.

EN ROUTE TO STOP 7 (11½ miles).

We return north along Point Judith Neck to Wakefield, and then cross the head of Point Judith Pond on the new bypass. US 1 goes west and southwest across ablation moraine, around the east end of the Charlestown moraine, and then west along the foot of the moraine, with outwash plain and low till areas south of the highway.

STOP 7. Cuts on north side of Post Road (US 1), just west of Gravelly Hill Road, Kingston quad. (114,350 ft. N, 477,350 ft. E)

The Charlestown moraine has recently been described and interpreted by Kaye (1960). This moraine, which is presumably correlative with the Harbor Hill moraine of Long Island and the moraines of Cape Cod, was formed from a belt of thick ablation moraine along the ice front, derived probably from a zone of shear planes. The present complex topography and structure of the moraine were developed by lowering and lateral shifting of the ablation moraine as the dead ice beneath it melted. This topography is essentially an inverted image of the ice surface during the last stages of wastage. Among the morphological types thus produced are ice-fracture fillings, colluvial ramparts, and ice-block casts (rimmed mounds).

At Stop 7, a private road cuts through a colluvial rampart of crudely stratified, light-gray, sandy till derived mostly from granitic rocks. Such marginal ridges probably formed from material sloughed down the steep side of the ice-cored moraine. Just to the north, an old pit in the side of a small ice-block cast exposes horizontally bedded sand overlying till. Such mounds are thought to have formed by filling of a hole in the ice caused by differential melting of a fracture-bounded ice block.

EN ROUTE TO STOP 8 (8½ miles).

We return a mile east along the moraine front, then turn north on Ministerial Road and cross the moraine, here about 1½ miles wide. The road crosses several ice-fracture fillings and much strongly kettled topography; Broad Hill just west of the road is a large rimmed mound. North of the moraine, we cross collapsed glaciofluvial deposits and a till ridge (Tobey Neck), and continue north-north-east through West Kingston on a broad outwash plain, the south part of which was probably built as a delta into a glacial lake in the Worden Pond basin.

STOP 8. Gravel pit about 3/4 mile north of University of Rhode Island, Kingston quad. (150,600 ft. N, 491,000 ft. E)

The outwash is somewhat collapsed toward the contoured kettle on the north side of the pit, and the till of the adjacent hill is exposed beneath a thin wedge of gravel on the east side. In much of the pit the top of the outwash is a thin, poorly sorted mudflow layer. The terrace is covered by eolian sandy silt that contains ventifacts.

This pit for several years has consistently provided the best exposures of late-glacial frost features in Rhode Island. The south and west parts of the pit show abundant involutions of the eolian material and the top of the gravel. The involutions are nearly symmetrical in vertical section and equidimensional in horizontal section, and may easily be distinguished from load casts or wind-throw structures. About ten ice-wedge structures have been exposed here; they vary from 1 to 2 feet wide at the top, and end at depths of 6 to 10 feet. They occur only as separate structures, not as nets, and the late-glacial permafrost may have been only thin and patchy and of short duration.

The kettle is partly filled with a poorly sorted solifluction deposit, and involutions on its east slope are overturned. The east side of the pit exposes solifluction tongues, composed of eolian material and boulders, that extended from the hillside onto the edge of the terrace.

EN ROUTE TO STOP 9 (½ mile).

We travel north on the outwash plain to its head.

STOP 9. End moraine east of Hundred Acre Pond, Slocum quad. (152,300 ft. N, 491,500 ft. E)

This narrow belt of bouldery knobs (Power, 1957) stands about 20 feet above the head of the outwash plain that includes Stop 8. A small pit beside the road shows collapsed sand and gravel, with many boulders and a few lenses of till-like material. This small moraine is likely correlative with similar features in the north-central and northwest parts of the Kingston quadrangle (Kaye, 1960, p. 381-382), and perhaps with a discontinuous moraine line extending west to Niantic, Conn. (unpublished information, Richard Goldsmith and J. P. Schafer). In southern New England, such small discontinuous moraines are known only within 20 miles of the south shore, and represent minor stillstands during the early part of retreat of the ice from the Charlestown moraine.

RETURN TO PROVIDENCE (33 miles).

We go south to Kingston, east on Route 138 to US 1 (formerly US 1A), and back to Providence on US 1 and Route 2.

REFERENCES

Kaye, C. A., 1960, Surficial geology of the Kingston quadrangle, Rhode Island: U. S. Geol. Survey Bull., 1071-I (1961).

-----, 1962, Early postglacial beavers in southeastern New England: Science, v. 138, p. 906-907.

Power, W. R., Jr., 1957, Surficial geology of the Slocum quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-106.

Smith, J. H., 1955, Surficial geology of the East Greenwich quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-62.

-----, 1956a, Surficial geology of the Providence quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-84.

-----, 1956b, Surficial geology of the Crompton quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-94.

Schafer, J. P., 1961a, Surficial geology of the Wickford quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-136.

-----, 1961b, Surficial geology of the Narragansett Pier quadrangle, Rhode Island: U. S. Geol. Survey Geol. Quad. Map GQ-140.

-----, 1961c, Correlation of end moraines in southern Rhode Island: U. S. Geol. Survey. Prof. Paper 424-D, p. 68-70.

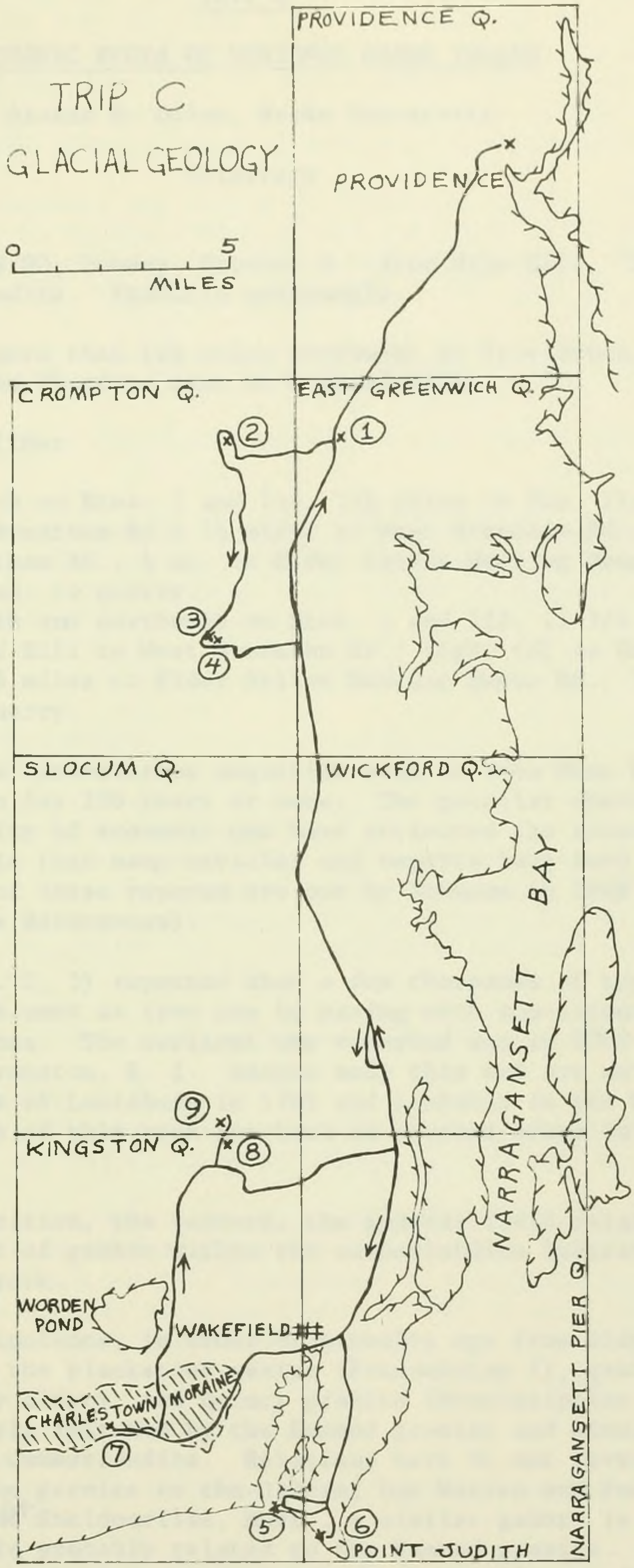

FIGURE C-1

Sketch Map of eastern and southern Rhode Island, showing localities for glacial trip.